plants were less than for younger ones at temperatures of 27° and 38° C.; though age seemed to make no difference at 49° C. Apparently the author overlooked the careful work on age and transpirational losses conducted by Bartholomew.

Records obtained from inserted thermocouples showed that a leaf exposed to radiation equivalent to that of noon sunlight may still maintain an internal temperature lower than that of the surrounding air. Transpiration reduced the temperature of the leaves 10° C. or less. At higher leaf temperatures the depression of the temperature of the leaf below the air decreased, probably due to the increased permeability of the cuticle and epidermal cell walls to water.

The regulatory power of stomata of *Helianthus* decreased as the air temperatures went up from 27° to 49° C. as shown by an increase in the ratios of night-time to daytime transpiration rates though the possibility of injury at 49° C. appears to have been disregarded.—H. S. Reed, Department of Botany, University of California, Berkeley.

Systematics and the Origin of Species from the Viewpoint of a Zoologist. By Ernst Mayr. Pp. xiv + 334. Columbia University Press, New York. 1942. $4.00.

This important work might better have been entitled "The Origin of Species [Microevolution] and [the Application of this Concept to] Systematics," for one does not have to read many pages before he discovers that traditional descriptive systematics has contributed very little to the discussion aside from the mechanics of nomenclature. The subject is approached from the broad viewpoint of a general biologist who not only understands the principles of genetics, ecology, morphology, physiology, and geographical distribution, but who is able to apply these to the problems of systematics. The result is a sound and pleasing philosophy of the nature of systematic units which seems to meet the requirements of the evidence from each of these diverse approaches.

As a specialist in one of the most highly developed branches of systematic biology (ornithology), Dr. Mayr is eminently well qualified to write on the subject of the origin of species and systematics. The biological array is so vast that it is only by the intensive study of a limited group that one may gain an insight into the forces which must govern the entire assemblage of groups. With a worldwide representation of only 8500 species (comparable in number to the "good" species of angiosperms indigenous to the western United States, but incomparably better known), the birds offer unusually favorable material for the formulation of biological principles. The systematic botanist may find many of Dr. Mayr's illustrative examples unfamiliar, but often he will be

able to supply similar examples from his experience with plant species.

Dr. Mayr conceives a species as a dynamic unit. "Species are groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups [p. 120]." As such, the species is a natural and an evolutionary unit, but it is not necessarily morphologically uniform. As a matter of fact, morphological uniformity is not a characteristic of most such species. The acceptance of this concept of polytypic species disposes of a difficulty against which cataloging systematists have been struggling for years. Whether each distinguishable geographical variant should be described and named as a subspecies (even if only 75 per cent of its individuals are determinable!) as is the practice of the ornithologist, or nomenclatorially ignored as is the preference of most systematic botanists is a question upon which there will continue to be diversity of opinion. The recognition of named geographical subspecies by the ornithologist is a compromise between the "lumpers" and the "splitters" among the taxonomists of the morphological school. To impose this compromise on groups which have never been split consistently into the smallest elements which could be distinguished even part of the time would not in the opinion of the reviewer simplify the classification of those groups. It may be sufficient to understand that most biological species do vary geographically.

The suggestion that the microgeographic races (jordanons) among plants do not have an exact homologue among animals is probably incorrect. This error possibly is due to a failure to realize the total magnitude of the barrier to free interbreeding imposed by immotility and habitat requirements. Microgeographic races among plants are the expression of genetic isolation of the same magnitude and sampling errors of the same kind as result in geographical subspecies among animals. They are equally distinct. If Dr. Mayr's criterion of a geographical subspecies is that it be regional rather than local, he may find such phenomena among those plants which have overcome the barrier of distance through the development of wind pollination or of highly effective mechanisms of seed dispersal.

Although he defines a species as consisting of "actually or potentially interbreeding natural populations," Dr. Mayr points out that many unquestionably distinct species are able to interbreed when brought together experimentally. Barriers which ordinarily would prevent interbreeding are often ineffective under artificial conditions. The important point is not whether two entities can interbreed or not, but whether or not they actually have done so in nature to the extent that their distinctive characteristics have become obscure. The existence of natural hybridization between species and even genera is freely admitted,

and criteria for the recognition of such secondary intergradation between distinct entities are clearly presented.

Genera are believed to be natural and monophyletic groups of species, although the exact size and content of a particular genus must necessarily be governed by taxonomic convenience and the preference of the individual systematist. Thus, unlike species, genera in different groups may not necessarily be comparable units. Among the birds, for instance, there are recognized at the present time some 2600 genera which average 3.27 species each. Dr. Mayr would consider "an average of 5 species per genus . . . definitely preferable to the present ratio." Genera of this small size would scarcely be advocated by the most extreme "splitters" among the plant taxonomists. Higher categories are admitted to be even more subjective.

Few thinking systematists would seriously question the validity of Dr. Mayr's principal generalizations. For the most part, very wisely, he has left their application in groups with which he is not familiar to specialists in those fields. As has been pointed out, there seems to be little occasion at the present time to apply the concept of polytypic species to the nomenclature of plant species, at least not to the same extent to which it has been found useful among the birds. This is particularly true in the genus *Calochortus* with which this reviewer is most familiar. Here, contrary to Dr. Mayr's suggestion, each of the species groups (subsections) is not comparable to a polytypic species, but to many an avian genus! The vast majority of the species of *Calochortus* are polytypic, so much so that the consistent description and naming of geographic subspecies would burden the nomenclature of this genus with hundreds of cumbersome trinomials. Such certainly would confuse, not simplify, the existing situation.

The appearance of Dr. Mayr's lucid and stimulating book marks an important point in the development of a sane and comprehensible biological classification. It is a fitting companion volume to Dobzhansky's "Genetics and the Origin of Species," and like that work should be read and understood by every individual who would be called a systematist.—Marion Ownbey, State College of Washington.